

A Review of the Genus *Gosodesmus* Chamberlin, with the Synonymy of *Eucybe* Chamberlin (Diplopoda: Platydesmida: Andrognathidae)

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Abstract: The genus *Gosodesmus* Chamberlin is reviewed. With a relatively large series of *G. claremontus* Chamberlin from a number of localities in California, a more thorough evaluation of this species is presented. Until now a series of disjunct populations have been given specific rank, but our studies indicate *G. claremontus* to represent a polymorphic species. Herein, we place the genus *Eucybe* Chamberlin, including the species *E. clarus* Chamberlin (1941), *E. longior* Chamberlin (1950), and *E. auctus* Chamberlin (1954) under the synonymy of *Gosodesmus claremontus*.

The millipeds of the super-order Colobognatha are delicate animals with a thin cuticle and small mouthparts modified for specialized feeding. At the time that the first and only comprehensive work on the North American fauna was published (see Cook and Loomis, 1928), it was felt that the Colobognatha existed in the temperate zone only as localized populations of a previously widespread fauna which was largely eliminated with the recent reduction of moisture in the temperate zone. It is now evident that certain species are indeed highly localized as predicted. Certain other groups of Colobognatha, however, have successfully adapted to the new conditions and rank among the more common and widespread forest millipeds in the western United States. Among these is a very slender, pink Andrognathid which has been given the generic names *Gosodesmus* and *Eucybe*.

Found abundantly in the middle and southern Sierras and Coast Ranges, this milliped has undergone an undue amount of taxonomic confusion. Chamberlin (1922) described *Gosodesmus claremontus* from Claremont, Los Angeles County, California. The description is brief, but accurate and useful, and the drawings accurately depict the creature. Cook and Loomis (1928) include *Gosodesmus* in their basic work on the Colobognatha, drawing their treatment from the original description. Loomis (1936) added significant new distribution records from Santa Cruz, County. Then Chamberlin (1941) described the genus and species *Eucybe clarus*, from Monterey County, California, but did not compare his new genus with *Gosodesmus*, even though the descriptions of the two groups correlated very well. Later, Chamberlin (1950) described a second species in the group, *Eucybe longior*, from Tulare County, California, basing the species mainly on its greater number of segments. The third and final species, *Eucybe auctus*,

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was described by Chamberlin in 1954 and was collected in Mariposa County, California. It was distinguished by the presence of three rows of tubercles on the collum, versus two for *clarus*. In the North American Checklist of Chamberlin and Hoffman (1958), all of the above names except *E. auctus* were included as recognized species, the latter being omitted because it was published beyond the deadline date for accepting titles for the 1958 list. Buckett (1964), however, included all four names in the Annotated Checklist of the Millipeds of California.

We wish to express our sincere appreciation to Mr. H. F. Loomis for making available for study the Andrognathid material in his collection.

TAXONOMIC CHARACTERS

In the Colobognatha in general, and in the Platydesmida in particular, the somatic features offer the most useful and reliable characters. Unlike the Helminthomorpha, in which the gonopods present obvious specific and generic characters, the gonopods of the Colobognatha are of relatively little use in distinguishing species.

In the western species of the Platydesmid family Andrognathidae, the numbers of segments, the shape and configuration of the body segments (of the collum in particular), and the presence or absence and nature of tergal tubercles are most useful in distinguishing taxonomic units.

The collum and its tubercle arrangement are of particular interest in the group of millipeds upon which the names *Gosodesmus* and *Eucybe* are based. The tubercles are prominent rounded projections of varying sizes and shapes, and are arranged in two or three rows. However, the arrangement is often uneven, and random tubercles are usually present. In the original diagnosis of *Gosodesmus*, Chamberlin indicated that he understood the inherent variability of this character, stating: "First tergite with six tubercles in each row, or with one or two extra ones in an indistinct third row along anterior border." However, in his later publications on *Eucybe*, Chamberlin placed particular emphasis on the number of rows of tubercles on the collum, using this character as the primary diagnostic feature in distinguishing *Eucybe auctus*.

Another character which has been used to diagnose "species" in this group is the segment number. *Eucybe longior* Chamberlin was distinguished from *E. clarus* on the basis that it possesses 70 segments as opposed to 55 for the type of *clarus*. The facts appear to indicate, however, that the number of segments is not tightly controlled genetically. For instance, adult individuals from Marin County vary from 50 to 68 segments. Hence, this character cannot be relied upon to indicate species distinctness in this group.

Genus *Gosodesmus* Chamberlin

Gosodesmus Chamberlin, 1922, Pomona Coll. J. Entomol. and Zool. 14(1):9.

(Type species: *Gosodesmus claremontus* Chamberlin, by original designation).

Eucybe Chamberlin, 1941, Bull. Univ. Utah, biol. ser. **6**(4):3 (Type species: *Eucybe clarus* Chamberlin by original designation). **New Synonymy.**

DIAGNOSIS: *Gosodesmus* may be easily recognized by the narrow body (L/W ratio of 12) with 2 rows of tubercles on regular body tergites as well as a tuberculate colum with paranotal flanges developed.

DESCRIPTION: Body long and slender, length/width ratio about 12; color in life pink to nearly coral, often with black median dorsal stripe.

Head sub-triangular with sides strongly converging below, the labrum sharply rounded; eyes absent; antennae short, widening apically, segment 6 much the largest. Collum hardly wider than head, with paranota as well developed, proportionately, as on succeeding segments; two or three uneven rows of round or elongate tubercles present on collum, numbering from 10 to 25 tubercles total.

Following segments 2 to 7 gradually widening, on anterior segments paranota directed considerably cephalad, this anterior curvature gradually reduced and absent by segment 7.

Segments fitting so that paranota are loosely spaced, a portion of prozonite exposed between metazonites; segments other than collum (with the occasional exception of segment 2) with two transverse rows of tubercles, an anterior row of 6 to 8 tubercles on each side, the outer pair of which situated on basal half of paranota, and a posterior row of 4 to 7 tubercles on each side not extending onto paranota; tubercles rounded on anterior segments, becoming longitudinally elongate in middle body segments; paranota of middle body segments angled sharply cephalad at origin, then angled laterad, the angle sharper on caudal margin; surface of paranota roughened, the margins minutely tubercled; the repugnatorial pores opening very near caudal apex of lateral margin.

Legs long, extending beyond lateral margins of body.

Gosodesmus claremontus Chamberlin.

Gosodesmus claremontus Chamberlin, 1922, Pomona Coll. J. Entomol. and Zool.

14(1):9, 3 Figs.; Cook and Loomis, 1928, Proc. U. S. Nat. Mus. **72**:26;

Loomis, 1936, Proc. U. S. Nat. Mus. **83**:364, Fig. 32c; Chamberlin and

Hoffman, 1958, Bull. U. S. Nat. Mus. **212**:184; Buckett, 1964, Annot. List

Diplopoda California, p. 28.

Eucybe clarus Chamberlin, 1941, Bull. Univ. Utah, biol. ser. **6**(4):3 (type

locality: Monterey County, California; type: Collection of R. V. Chamberlin);

Causey, 1954, Pan-Pacific Entomol. **30**:221; Chamberlin and Hoffman,

1958, Bull. U. S. Nat. Mus. **212**:183; Buckett, 1964, Annot. List Diplopoda

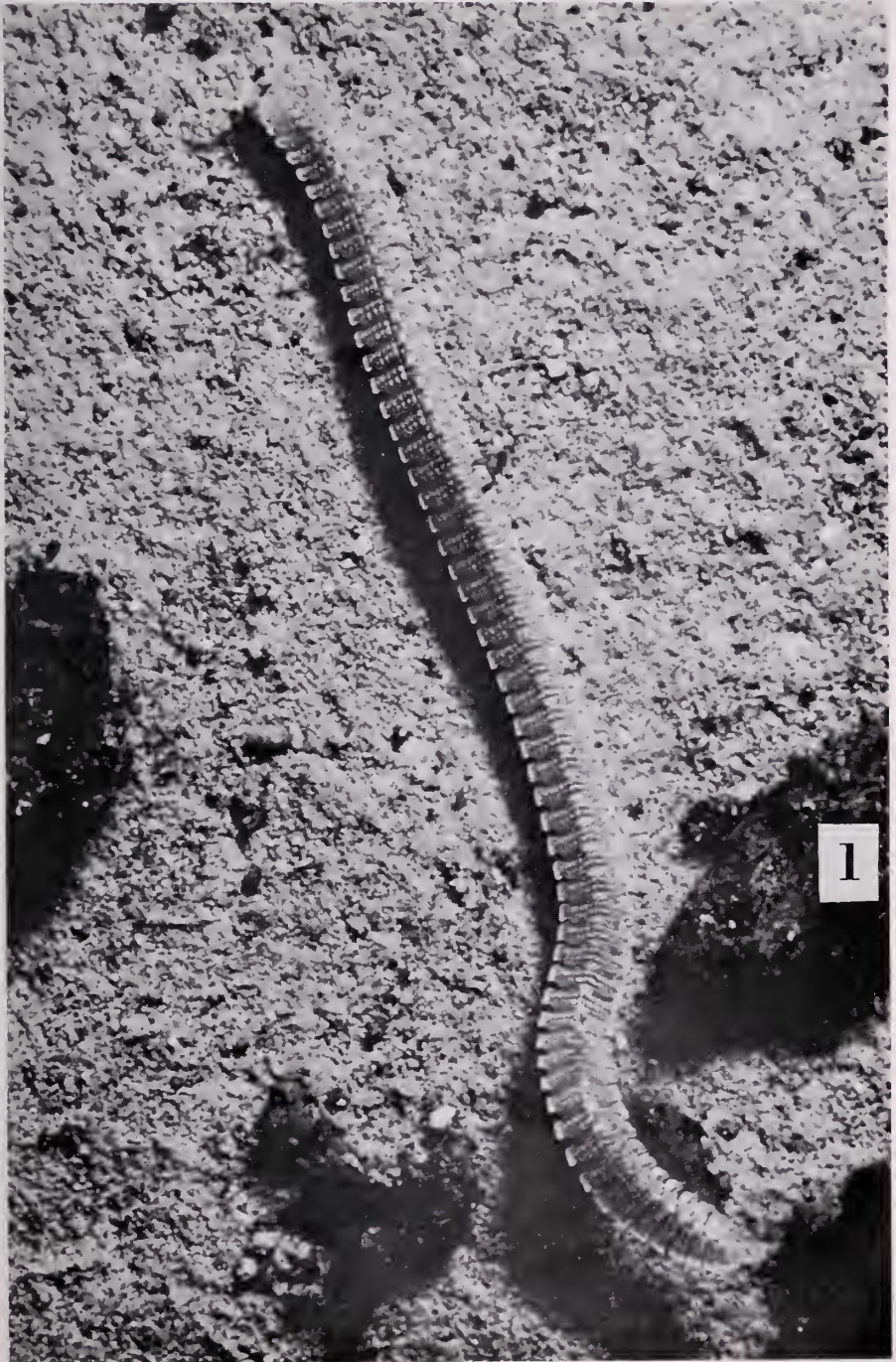
California, p. 28. **New Synonymy.**

Eucybe longior Chamberlin, 1950, Chicago Acad. Sci. Natur. Hist. Misc. No. **68**:

4 (type locality: Tulare County, California; type: Collection of R. V.

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FIG. 1. *Gosodesmus claremontus* Chamberlin, adult male. Note body shape, minutely roughened tergites, and arrangement of dorsal tubercles.



Chamberlin); Chamberlin and Hoffman, 1958, Bull. U. S. Nat. Mus. **212**: 183; Buckett, 1964, Annot. List Diplopoda California, p. 28. **New Synonymy.**

Eucybe auctus Chamberlin, 1954, Proc. Biol. Soc. Washington **67**:233 (type locality: Mariposa County, California; type: Collection of R. V. Chamberlin); Buckett, 1964, Annot. List Diplopoda California, p. 27. **New Synonymy.**

TYPE LOCALITY: Claremont, Los Angeles County, California.

TYPE: In the Museum of Comparative Zoology, Harvard University, Cambridge, Mass. Description, based on specimens from Santa Cruz County, California.: Body strikingly pink in color.

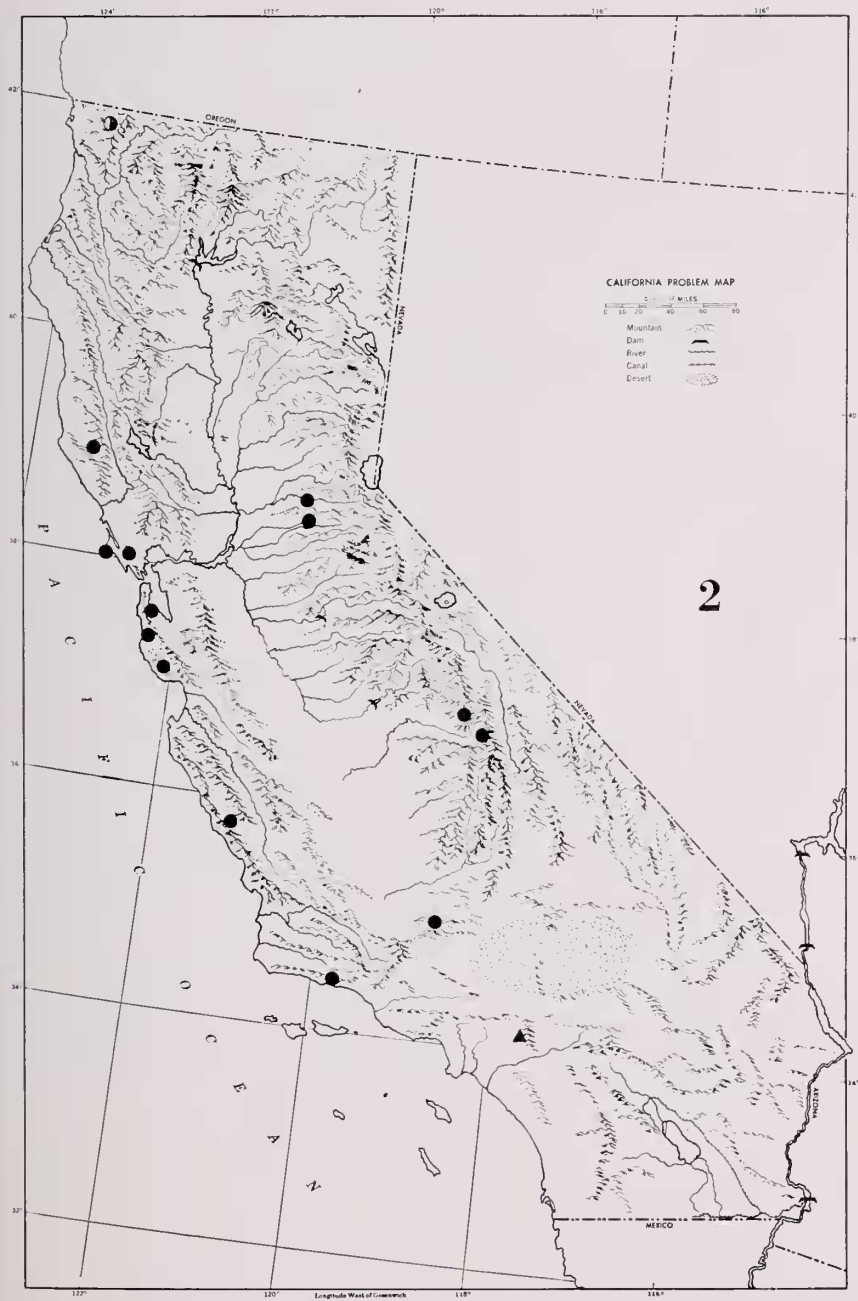
Head narrower than collum and completely uncovered by collum; frontal area flattened, covered with minute setae; coronal suture not evident, a pair of small dark brown oval areas closely situated on either side of median line about one-third distance from dorsum; antennal sockets deeply set into facial shield slightly below mid-height of head; head sub-triangular from frontal aspect, broadly rounded dorsally and narrowing evenly to sharply rounded labral area; antennae short, separated by distance equal to twice length of second antennal segment; first antennal segment short, cylindrical, reaching to lateral margin of facial shield; segment 2 twice length of first segment, much widened apically; segments 3 and 4 equal to 2 in width but distinctly shorter; segment 5 slightly longer than 4 and almost twice apical width of segment 4; segment 6 the largest, cylindrical; apical segment sub-equal in size and shape to segment 1, with four apical sense cones in truncate apex; antennal segments densely covered with fine setae.

Tergites with surface minutely roughened, not shining; margins of paranota with numerous minute spines and tubercles; median dorsal sulcus prominent on both prozonites and metazonites. Collum narrower but longer than following segments, with small but distinct rounded paranotal flanges, these directed slightly cephalodorsad; posterior margin of collum curved evenly convex, anterior margin concave; paranota of collum with dense, minute teeth; dorsal surface with prominent tubercles of varying shapes and sizes usually situated in 2 to 4 uneven rows; posterior row consisting usually of 6-10 large elongate tubercles, others on the collum more rounded; overall tubercle number on collum varying from 10 to 25.

Segment 2 short, with larger paranota raised 15° from horizontal and directed slightly cephalad, the apices broadly rounded; tubercles on second segment in

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FIG. 2. Distribution map, *Gosodesmus claremontus*. The triangle represents the type locality; the half-filled circle represents a record published by Causey (1954); the full circle represents collections made by the authors.



two rows, an anterior row of 5 small tubercles on the left and 3 on the right, and posterior row of 2 large, rounded tubercles on each side; outer tubercle of anterior row on basal half of paranota flange; segments 3 and 4 similar to segment 2 in shape, but increasingly larger, each with increasingly more numerous tubercles; beginning prominently on segment 5, a sharp right-angled notch present on posterior margin of paranotal flange at juncture with margin of body cylinder, this notch increasing in size on following segments; segment 5 with 8 elongate tubercles in posterior row extending laterad to caudal notch on each side, the anterior row with 5 tubercles on the right side and 4 on the left; sixth and following segments with laterally compressed tubercles comprising both anterior and posterior rows and with paranota directed strictly laterad; sixth tergite sub-quadrate in shape, with a small notch in the center of lateral margin cephalad of location of repugnatorial pore; segments 7 through 10 with posterior corner of paranota becoming produced and sharply acute, the anterior corners rounded; tubercles on middle body segments in two rows, with 6 to 8 in the anterior row on each side of body and 4 to 7 in posterior row on each side.

Tergites of last 7 segments gradually reduced in size, the posterior corners becoming increasingly produced; last 4 segments with paranota curving increasingly caudad, the last pair of flanges with mesal margins parallel, adjacent to lateral margins of anal tergite and equalling it in length; anal segment cylindrical, covered with fine setae; 6 long setae present around caudal margin of anal tergite; anal valves smooth, bearing fine setae and produced slightly beyond anal tergite; preanal scale apparently absent.

Sternal process oval, produced cephalad between coxae of each leg-pair; anterior legs of male crassate, slightly shorter and stouter than other walking legs; normal walking legs with coxae large, mesal margins almost meeting anteriorly; second leg segment very short, barely noticeable; third segment elongate, nearly twice length of coxa; fourth, fifth and sixth segments all decreasing in size, considerably shorter than third segment; seventh segment the longest, narrowing distad to width of apical claw; coxae with rounded apical protrusions on postero-ventral surface of all legs except those of last 18 segments.

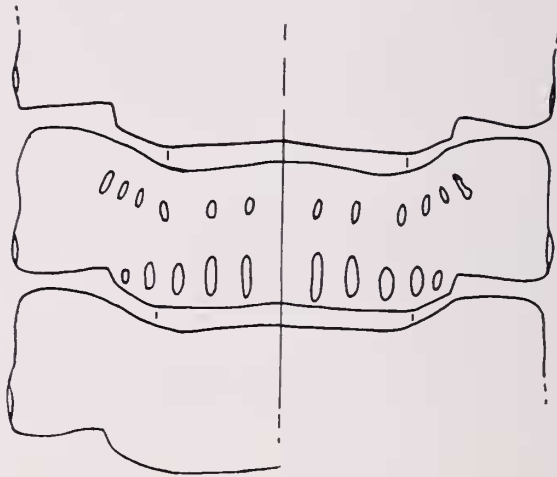
Gonopods consisting of 2 pairs of segmented leg-like appendages tapered toward their apices; anterior gonopod short, sharply curved cephalad with the apical segment longest; posterior gonopod more elongate, proceeding cephalad and ending adjacent to mesal margin of anterior gonopod.

SPECIMENS EXAMINED: California: Amador County: 5 males, 2 females, 4 miles east of Fiddletown, 20 January 1968 (J. S. Buckett & M. R. Gardner); 1 female, 3 miles south-southeast of Jackson, 27 December 1965 (J. S. B., M. R. & R. C. Gardner). Calaveras County: 5 males, 10 females, 3 miles south of Westpoint, 19 January 1968 (J. S. B. & M. R. G.). Kern County: 4 males, 5 females, 1 mile north of Fort Tejon Monument, 17 December 1967 (J. S. B. & M. R. G.). Marin County: 2 males, 2 females, Inverness Ridge, 1 mile south of Inverness, 7 November 1964 (J. S. B. & M. R. G.); 1 male, 5 females, Lagunitas, 9 January 1965 (J. S. B. & M. R. G.); 3 females, Point Reyes Hill, 2 miles

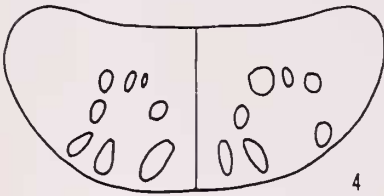
southwest of Inverness, 20 December 1961 (J. S. B. & G. M. Trenam). Mendocino County: 2 males, 3 females, 4 miles north of Yorkville, 21 December 1964 (J. S. B. & M. R. G.); 23 males, 21 females, 7 miles northwest of Yorkville, 21 December 1964 (J. S. B. & M. R. G.). Monterey County: 1 female, Alder Creek, 28 March 1965 (P. Richerson) San Mateo County: 7 males, 7 females, Stanford University, 29 December 1964 (J. S. B. & M. R. G.). Santa Barbara County: 1 male, Cold Spring, 1 mile north of San Marcos Pass, 19 June 1965 (J. S. B. & M. R. G.); 1 female, Jalama Beach, 9 July 1965 (M. R. G.); 2 females, Toro Canyon, 4 September 1967 (R. F. Denno). Santa Clara County: 1 male, 5.2 miles southwest of Stevens Creek Dam, 28 December 1966 (M. R. G., R. C. G., & S. E. Harrison); 3 females, 10 miles south of Woodside, 29 December 1966 (M. R. G., R. C. G. & S. E. H.). Santa Cruz County: 3 males, 8 females, Ben Lomond, 29 December 1966 (M. R. G., R. C. G. & S. E. H.); 1 male, 4 females, 2 miles northwest of Boulder Creek, 29 December 1966 (M. R. G., R. C. G. & S. E. H.). Tulare County: 1 female, 4 miles south Badger, 11 February 1967 (J. S. B. & M. R. G.); 7 males, 11 females, 3 miles north of Hospital Rock Camp Ground, Sequoia National Park, 12 February 1967 (J. S. B. & M. R. G.).

As with almost any wide-ranging species, considerable variation occurs within and between populations of *Gosodesmus claremontus*. The most obvious superficial characteristic is color. Specimens from the coast ranges north of Monterey County, California, are a bright pink color over their entire dorsal surface, sometimes with a purplish mid-dorsal stripe. The head is light tan in color. Specimens collected from the Sierras also display the bright pink color, but possess a mid-dorsal black stripe of varying widths, which may encompass from one to three tubercles of the anterior row centrally on each side of the tergite. The stripe widens cephalad to encompass the entire dorsal surface of the first 5 to 7 segments. In these specimens, also, there is a large black area encompassing the vertex of the head, this black area continuing down the middle of the frons, abruptly narrowing and ending before reaching the level of the antennae. This Sierran color form is also visible in specimens from Fort Tejon Monument, Kern County, and in specimens from localities in Santa Barbara County on the coast. Although the different color patterns are easily recognizable, they are probably not of much taxonomic significance, since some specimens from the Sierras, especially in the north, lack the black pigment almost entirely.

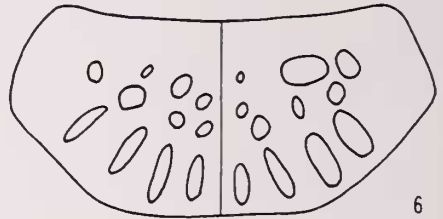
The number of rows of tubercles on the collum has previously been used as a character, but it is impossible to analyze because of the uneven displacement of the tubercles (See Figs. 4-7). A more objective character which can be analyzed statistically, however, is the number of tubercles on the collum. It was found that the mean number of tubercles of 18 Sierran specimens (including those from Fort Tejon) was 22, with a range of 17 to 25. Of 30 adult coastal specimens measured, the mean was found to be only 15, with the range from 10 to 19. Tested with the Student's T Distribution, the means were found to be highly significantly different; that is, the chance of the means of the populations from which these samples were taken being the same is less than 0.001. There is, then, on the average, 5 more tubercles on the collums of the Sierra specimens



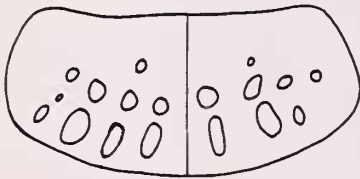
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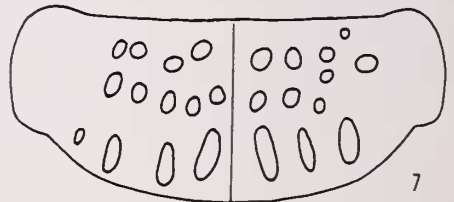
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FIG. 3. *G. claremontus*. Terga of mid body segments. Note loosely spaced segments, and arrangement and shape of tubercles.

FIG. 4. Female, Point Reyes Hill, 2 miles southwest of Inverness, Marin County, 20 December 1961 (J. S. Buckett & G. M. Trenam). Specimen composed of 55 segments.

FIG. 5. Female, Alder Creek, Monterey County, 28 March 1968 (P. Richerson). Specimen composed of 40 segments.

FIG. 6. Female, 3 miles north of Hospital Rock, Sequoia National Park, Tulare County, 12 February 1967 (J. S. Buckett & M. R. Gardner). Specimen composed of 70 segments.

FIG. 7. Male, same locality, date and collectors as in Fig. 6. Specimen composed of 81 segments.

than on the coastal specimens. Significantly, the Santa Barbara specimens which exhibited the Sierran color form averaged only 16 tubercles on the collum.

Another significant source of variation occurs in the size of the tubercles. The Sierran specimens usually have large, well-defined tubercles across all the segments, whereas in the coastal populations the tubercles diminish in size in the lateral areas of the tergites. Again, the tubercles of the Santa Barbara specimens resemble other coast specimens.

The final character of obvious importance is size, which is related to number of segments. In describing *Eucybe longior*, Chamberlin distinguished it from *E. clarus* by the fact that his specimens had from 65 to 75 segments as opposed to 55 for the type of *clarus*. Segment counts which we made revealed an average of 59.10 segments on the coast specimens with a range of 50 to 68. The average segment count of Sierran specimens was almost identical, at 59.11, with a range of 47 to 81. It is true that the largest specimens were collected from vicinity of Tulare County, although the significance in size of such specimens is reduced by the presence in the same population of adult individuals with less than average numbers of tubercles.

We have reached the conclusion in our study that the names *Gosodesmus claremontus*, *Eucybe clarus*, *E. auctus* and *E. longior* all represent a single, widespread species. In describing *Eucybe*, Chamberlin (1941) compared it with *Ischnocybe* Cook and Loomis, but ignored his own *Gosodesmus*, the diagnosis of which agreed with the diagnosis of *Eucybe* in every respect. In erecting the species *longior* and *auctus*, Chamberlin relied on characters which later proved to be too variable to indicate species integrity; namely, the number of segments in *longior* and the number of rows of tubercles in *auctus*.

Of the North American genera of Andrognathidae, *Gosodesmus* appears closely related to the genus *Ischnocybe* Cook and Loomis. Like *Gosodesmus*, *Ischnocybe* has about 60 body segments, a length/width ratio of about 12, 2 rows of tubercles on the body segments, well developed, loosely fitting paranota, head with obtusely angular snout and antennae with enlarged sixth segment. *Ischnocybe* differs from *Gosodesmus* mainly in the characters of the collum, in which it lacks both tubercles and the paranotal flanges.

Relationships with other groups are more obscure. From its description, *Stenocybe waipea* Chamberlin appears to be similar to *Gosodesmus* in body form. However, more must be known about the former before accurate comparisons can be made. Also, the genus *Brachycybe* Wood shares several features with *Gosodesmus*, even though *Brachycybe* has a much broader body. Both genera possess two rows of tubercles on most body segments as well as tuberculate, flanged collum, and similar numbers of segments. The European genus *Fioria* Silvestri, as pointed out by Cook and Loomis (1928), may also be related to *Gosodesmus*, as it possesses a similar pattern of dorsal tubercles, although these are apparently of a different nature.

The ecology of these animals, as far as it is known, appears to support the ideas founded on morphology. *Ischnocybe*, *Gosodesmus* and *Brachygybe* have all been collected in rotting wood. In fact, on one occasion in Marin County, we collected several specimens of *Gosodesmus* freely intermingling with *Brachygybe* on an oak stem. By contrast, a genus of apparently different origins, *Mitocybe*, was collected in loose, rocky soil.

Literature Cited

- BUCKETT, J. S. 1964. Annotated list of the Diplopoda of California. Simmons Publ. Co., Davis, California, 34 pp.
- CAUSEY, N. B. 1954. New records and species of millipeds from the western United States and Canada. Pan-Pacific Entomol., **30**: 221-227, figs. 1-5.
- CHAMBERLIN, R. V. 1922. A new Platydesmoid Diplopod from California. Pomona Coll. J. Entomol. and Zool., **14**: 9-10, 3 figs.
- . 1941. New American millipeds. Bull. Univ. Utah, biol. ser., **6**: 1-39.
- . 1950. Three new genera and eight new species of western millipeds. Chicago Acad. Sci., Natur. Hist. Misc., **68**: 1-6.
- . 1954. Six new California millipeds. Proc. Biol. Soc. Washington, **67**: 231-234.
- AND R. L. HOFFMAN. 1958. Checklist of the millipeds of North America. Bull. U. S. Nat. Mus. **212**: 1-236.
- COOK, O. F. AND H. F. LOOMIS. 1928. Millipeds of the order Colobognatha, with descriptions of six new genera and type species, from Arizona and California. Proc. U. S. Nat. Mus., **72**, art. 18: 1-26 pp.
- LOOMIS, H. F. 1936. Three new millipeds of the order Colobognatha from Tennessee, Texas, and Lower California, with records of previously known species. Proc. U. S. Nat. Mus., **83**: 361-368.